Equipment Efficiency Standards Appendices

These appendices include tables of minimum equipment efficiency standards for cooling, lighting, and motors, as well as other supplemental information about the program. This information is also available on the program Web site at **http://www.AEPefficiency.com**.

A M&V Sampling Guidelines

Overview

This appendix provides guidelines for defining a sample of equipment for measurement and verification purposes. In sampling, a large number of similar pieces of equipment affected by the same energy-efficiency measure can be grouped into usage groups from which samples are selected. These sampling guidelines are designed to provide assistance in determining the number of sample points that should be monitored in order to meet the program precision requirements and provide a reliable estimate of parameters such as annual energy savings or hours of operation. If alternative approaches are proposed, they must be approved by AEP and based on sound statistical principles.

Steps in Calculating Sample Size

The number of pieces of equipment requiring monitoring can be calculated according to the following steps:

1. Compile measure information

Compile the following information for the equipment affected by the measures. This step is normally undertaken during the preparation of the Final Application.

- *Number of Fixtures/Equipment.* Identify and document the fixtures/equipment that are affected by the installation of measures in a survey that includes nameplate data, quantity of equipment, and location information.
- *Projected Hours of Operation*. Project the average hours of operation of the equipment. It should be based on the experience of the building operator, on the operation of the affected equipment or even some preliminary monitoring.

2. Designate usage group

Next, provide a brief description of the functional use of the space being audited. Functional uses typically encountered in lighting for commercial and industrial facilities are provided in Section III, Chapter 2, Table 2.3 of this manual. Usage groups for non-lighting measures are dependent on type of application. Sources of information on operating characteristics, other than monitoring, used in defining usage groups include: (a) operating schedules that provide information on energy consumption or hours of operation; and (b) type of application or location that provides information on how and when equipment (e.g., fixtures or motors) are operated. In some instances, area type alone may be insufficient to designate usage groups. Usage groups may need to be further subdivided if an area type is inherently variable in nature due to different characteristics of their occupants. For example, some laboratories may have longer operating hours than others and should be divided into different usage groups (e.g., computer laboratory lighting operates for 8 hours per day while agriculture laboratories operate 4 hours per day).

3. Calculate sample sizes

Once the equipment has been divided into usage groups, the total sample size needed for these groupings can be calculated. This approach produces a sample (with a coefficient of variation of 0.5) expected to estimate the average hours of operation with sufficient accuracy. The following table shows the number of samples required in a usage group.

Table A.1: Sample Size based on Usage Group Sampling

Usage Group Population	Sample Size 80/20	Sample Size 80/20, plus 10%
4	3	4
5	4	5
12	6	7
16	7	8
20	7	8
25	8	9
30	8	9
35	8	9
40	9	10
45	9	10
60	9	10
65	9	10
70	9	10
80	10	11
90	10	11
100	10	11
125	10	11
150	10	11
175	10	11
200	10	11
300	10	11
400	11	13
500	11	13

Over-sampling

The initial sample size should be increased to compensate for potential reductions in the final usable sample due to equipment failure or loss. Suggested guidelines are that the sample size be increased by 10 percent.

B M&V Example

Project Summary

An owner of a 250,000 square foot office complex is participating in AEP's Commercial and Industrial Standard Offer Program. A central chilled water plant cools the facility with a 15-year-old 700-ton centrifugal chiller. The owner of the building is planning to replace the older chiller with a new, high efficiency unit. The new unit under consideration is rated with an ARI nominal COP of 6.4 (0.55 kW/Ton). The baseline and minimum efficiency standards for water-cooled electric chillers is taken from Appendix A, Table 7 of the *Standard Cooling Equipment Tables*. For a 700-ton water-cooled chiller, the baseline efficiency is 4.7 COP, which is equivalent to 0.748 kW/ton. Likewise, for a 700-ton water-cooled chiller, the minimum efficiency is 6.1 COP, which is equivalent to 0.577 kW/ton (and the unit qualifies for the program by having a higher efficiency than the required minimum).

Assumptions

This M&V plan is written with the following assumptions:

1. The office building is not planning any major projects that would significantly alter the chiller load or schedule, such as building additions, significant changes in building occupancy, or significant changes in building schedule.
2. The chiller operating schedule will not change because of this project.

Based on the assumptions and the fact that the new chiller is similar to the existing one (similar size, water-cooled, no VFD, etc.), the only characteristic needed to estimate the demand and energy savings is the full load efficiency of each chiller.

Project Activities

The proposed method for conducting the M&V is from Section III, Chapter 3: *Guidelines for Replacement of Cooling Equipment*. Since the simplified guidelines are being used, pre-installation monitoring is not required. The project does require pre-installation and post-installation inspections, post-installation monitoring of chiller demand (kW for at least one hour at peak operating conditions), post-installation monitoring of chiller consumption (kWh for the entire year), an Installation Report, and a Savings Report. The Project Sponsor shall be responsible for all M&V activities and production of reports.

Inspections

AEP shall perform a pre-installation inspection to validate assumptions used in the savings calculations, and verify the existing chiller efficiency. The best source of information for the existing efficiency is the ARI certification, which accompanies the existing chiller. A post-installation inspection will be performed to verify that the chiller was installed and is operating as proposed in the approved Final Application.

Post-Installation Monitoring

Post-installation monitoring of chiller electrical consumption shall be conducted for the entire M&V period. This monitoring will be accomplished using an ACME Inc, self contained, three-phase, true RMS kW logger. The logger collects time stamped data at 15-minute intervals. The logger will be downloaded monthly and the data validated and stored. In the event that there is a significant gap in the data due to a logger failure, the process to replace the missing data with interpolated or averaged data will be clearly documented. The 15-minute time stamped data will be used to satisfy all post-installation monitoring requirements.

Reports

After the chiller is installed and commissioned, an Installation Report will be produced documenting that the equipment specified in the FA was installed and is functioning as expected. A Savings Report, following the guidelines and forms provided in the procedures manual, will be generated and submitted upon completion of the data collection activities. Savings estimates will be provided in spreadsheet form, following the template provided in Table 2, below. In addition to the reports, all monitoring data will be submitted in electronic format for review by AEP.

Metering Plan

The electrical demand of the proposed (new) chiller will be monitored to support the required M&V activities. This three-phase load will be monitored using an ACME true RMS kW meter. Current Transducers will be placed on Breakers 1, 3 and 5 of switch-gear SG-1. These breakers are the A, B, and C phases of the 460 volt service that supplies the chiller. No other devices draw power from these breakers.

The ACME meter will record electrical consumption at 15 Minute intervals for the duration of the monitoring period. This logger is capable of storing 41 days of 15-minute data using a fifteen minute interval. Data will be downloaded and stored on the first working day of each month to ensure that the logger does not run out of memory.

Accuracy Requirements

The ACME logger will be calibrated at the time of installation and then checked for calibration every 6 months. This will be accomplished using a Powersite true RMS meter calibrated at the factory to ±2 percent of reading.

Data Gathering and Quality Control

The data will be collected using quality control procedures for checking reasonableness. Any and all missing intervals will be replaced either by interpolation or use of average values. AEP will be notified of any data substitution because of missing data, and the method employed to substitute the data.

Calculations and Adjustments

The calculations described below will be performed for the Savings Report and will form the basis of incentive payments. The nominal efficiencies of the chillers are provided again in Table E.1 below.

Table E.1: Proposed and Baseline Chiller Statistics

Chiller	Efficiency (COP)	Full-Load kW
Baseline	4.7	524
Proposed	6.4	385

Using the post-installation data described above and the information in Table E.1, the savings will be calculated using Equations E.1 and E.2.

Equation E.1: Calculation of Energy Savings

$$\text{Energy Savings [kWh]} = \text{Post Installation Metering [kWh]} \bullet \left\{ \left[\frac{\text{COP of new chiller}}{\text{Baseline COP}} \right] - 1 \right\}$$

Equation E.2: Calculation of Peak Demand Savings

$$\text{Demand Savings [kW]} = \text{Max Demand Measured [kW]} \bullet \left\{ \left[\frac{\text{COP of new chiller}}{\text{Baseline COP}} \right] - 1 \right\}$$

The ratio of new to existing chiller is computed as 6.4 divided by 4.7 to yield 1.36. Table E.2 below provides a template to illustrate how monthly savings calculations will be estimated when actual M&V data are available.

Table E.2: Template for Computing Savings

Time of Day	Measured kW for peak day in June (hourly average)	Peak savings (kW)	Average demand profile in June (kW)	Days of Operation for June	Energy Consumption (kWh)	Energy Savings for June (kWh)
0:00	127.0	45.7	82.6	23	1899	684
1:00	142.4	51.3	92.6	23	2129	767
2:00	134.8	48.5	87.6	23	2015	725
3:00	127.0	45.7	82.6	23	1899	684
4:00	134.8	48.5	87.6	23	2015	725
5:00	127.0	45.7	95.3	23	2191	789
6:00	142.4	51.3	106.8	23	2456	884
7:00	173.2	62.4	129.9	23	2988	1076
8:00	269.6	97.1	202.2	23	4651	1674
9:00	288.8	104	216.6	23	4982	1793
10:00	319.6	115.1	271.7	23	6248	2250
11:00	346.6	124.8	294.6	23	6776	2439
12:00	354.2	127.5	301.1	23	6925	2493
13:00	358.0	128.9	304.3	23	6999	2520
14:00	362.0	130.3	271.5	23	6245	2248
15:00	365.8	131.7	274.4	23	6310	2272
16:00	365.8	131.7	274.4	23	6310	2272
17:00	346.6	124.8	260.0	23	5979	2153
18:00	327.2	117.8	245.4	23	5644	2032
19:00	308.0	110.9	200.2	23	4605	1658
20:00	192.6	69.3	125.2	23	2879	1037
21:00	127.0	45.7	82.6	23	1899	684
22:00	142.4	51.3	92.6	23	2129	767
23:00	115.6	41.6	75.1	23	1728	622
Total Savings:		131.7				35,248

The illustrative load data represents chiller consumption in the month of June. Energy savings (kWh) will be estimated in each month by multiplying the average hourly kWh with the number of days in the month and then applying equation E.1. The energy savings for each month will then be aggregated into an annual savings estimate. The peak data shall be used in equation F.2 to estimate the peak demand savings (kW).

C Service Territory Towns

STATE OF ARKANSAS	
Cities. Towns & Communities	**County**
Abbott	Scott
Ashdown	Little River
Avoca	Benton
Bestwater	Benton
Bethel Heights	Benton
Bingen	Hempstead
Blevins	Hempstead
Bonanza	Sebastian
Booneville	Logan
Cave Springs	Benton
Center Point	Howard
Centerton	Benton
Cove	Polk
DeQueen	Sevier
Dierks	Howard
Elm Springs	Washington
Eureka Springs	Carroll
Excelsior	Sebastian
Farmington	Washington
Fayetteville	Washington
Foreman	Little River
Fouke	Miller
Fulton	Hempstead
Gillham	Sevier
Greenland	Washington
Greenwood	Sebastian
Hackett	Sebastian
Hartford	Sebastian
Hatfield	Polk
Highland	Pike
Hiwasse	Benton
Horatio	Sevier
Huntington	Sebastian
Jenny Lind	Sebastian
Johnson	Washington
Lincoln	Washington

Little Rock	Benton
Lockesburg	Sevier
Lowell	Benton
Magazine	Logan
Mansfield	Scott & Sebastian
McCaskill	Hempstead
Mena	Polk
Midland	Sebastian
Mineral Spring	Howard
Monte Ne	Benton
Murfreesboro	Pike
Nashville	Howard
Ogden	Little River
Ozan	Hempstead
Pea Ridge	Benton
Prairie Grove	Washington
Rogers	Benton
Saratoga	Howard
Springdale	Washington
Texarkana	Miller
Vaughn	Benton
Waldron	Scott
Washington	Hempstead
West Fork	Washington
Wilton	Little River
Winthrop	Little River
TOTAL: 62	

D Irrevocable Letter of Credit Checklist

Irrevocable letters of credit (ILOC) may be accepted in lieu of security deposit from standard offer program (SOP) project sponsors who wish to participate in American Electric Power (AEP) energy efficiency programs. If an ILOC is presented, it must **specify** the following:

- The year of the SOP agreement
- The type of SOP contract agreement (i.e., Residential/Small Commercial, Hard-to-Reach, Commercial/Industrial, etc.)
- All parties to the agreement (i.e., the ILOC applies to the agreement "…to be entered by and between [specific name of the particular AEP company, not just AEP] and [full and complete name of project sponsor]")
- The amount of credit to be established as security, payable upon demand by AEP
- The full and complete name of the credit institution
- The full name and title of the contact person at the credit institution to whom the demand should be presented
- The expiration date of the ILOC

In addition, the ILOC **must** contain the following language:

Drafts must be accompanied by the following documents:

Presentation of document(s), signed by a duly authorized representative of AEP showing proof that [name of project sponsor] has failed to adhere to the Project Milestone Schedule established in the "Project Implementation" section of the [year] [specify which SOP] Agreement to be entered by and between AEP [specify which AEP company] and [name of project sponsor].

E

Irrevocable Letter of Credit Example

IRREVOCABLE LETTER OF CREDIT

DATE OF LETTER OF CREDIT

CUSTOMER – NAME AND ADDRESS	ISSUING FINANCIAL INSTITUTION NAME AND ADDRESS	NUMBER OF LETTER OF CREDIT AMOUNT (U.S.DOLLARS):
BENEFICIARY –NAME AND ADDRESS	ADVISING FINANCIAL INSTITUTION – NAME AND ADDRESS	EXPIRATION DATE TO BE AVAILABLE BY DRAFTS DRAWN AT:

ADVISING BANK/BENEFICIARY:

We hereby issue this Irrevocable Letter of Credit and authorize you as Beneficiary to draw on ourselves for the account of Customer for any sum or sums not exceeding in the aggregate the amount of this credit as indicated above.

Drafts must be accompanied by the following documents:

Presentation of documents(s), signed by a duly authorized representative of **[Beneficiary/A.E.P. Southwestern Electric Power Company - Name]**, showing proof that **[Customer/Project Sponsor - Name]** has failed to adhere to the Project Milestone Schedule established in the "Project Implementation" section of the 2003 AEP Commercial and Industrial Standard Offer Program Agreement to be entered by and between **[Beneficiary/A.E.P. Southwestern Electric Power Company - Name]** and **[Customer/Project Sponsor - Name]**.

Drafts drawn under this credit must be marked that they are drawn under this Financial Institution's Letter of Credit and must show the Date and Number of the Letter of Credit.

We hereby agree to honor each draft drawn under and in compliance with the terms of this credit, if duly presented (together with the documents specified) to us on or before the close of business on the Expiration Date shown above.

Unless otherwise expressly stated, this Credit is subject to the Uniform Customs and Practice for Documentary Credits (1993 Revision), International Chamber of Commerce Brochure No 500, and, where not inconsistent therewith, to Article Five of the Uniform Commercial Code of the state of the principal office of the Issuing Financial Institution. Unless otherwise expressly stated above, only original documents will be accepted. No reproductions or carbon copies may be substituted for originals.

Very Truly Yours,

_____

Authorized Signature – Issuing Financial Institution

_____

Print Name and Title

F

Project Sponsor Participation Process

Project Sponsor (PS)

American Electric Power SWEPCO (AEP)

1. **PS** Reviews C&I SOP Manual (on web site) – AEPefficiency.com
2. **PS** Completes and submits Initial Application [IA] (on-line)
    - (*if applicable* – Project Sponsor and Customer Agreement must be received by AEP within 15 business days of IA submittal)
3. AEP Reviews and Approves Initial Application
    - (within 15 business days of IA submittal)
4. **PS** Submits applicable documentation, hardcopy (see Appendix I)
5. **PS** Submits Final Application [FA] (on-line)
    - (within 15 business days from IA approval)
6. **PS** Submits Security Deposit
    - (must be received by AEP within 20 business days of IA approval)
    - *(the greater of $500 or 5% of the requested incentive amount)*
7. AEP Conducts pre-measure installation inspection
8. AEP Approves Final Application (within 45 business days of FA submittal)
9. **PS** Accepts, saves, prints, signs and submits two copies of the C&I SOP Agreement (from the web site)
    - (must be received by AEP within 15 business days of the FA approval)
10. AEP Signs the C&I SOP Agreement
11. AEP Mails one executed copy of the C&I SOP Agreement to the PS
12. **PS** Installs the new energy efficiency measure(s)
    - (within 6 months of the Effective Date of the Agreement)

13. **PS** Submits the Installation Report [IR] (on-line)

    - (within 15 business days from measure installation)

14. **PS** Submits applicable documentation, hardcopy (see Appendix I)

    - (*if applicable* – Customer Acknowledgement Form must be received by AEP within 15 business days from measure installation)

15. AEP Conducts post-measure installation inspection

16. AEP Approves the Installation Report

    - (within 30 business days of IR submittal)

17. **PS** Submits the Savings Report [SR] (on-line)

    - (within 18 months of the Effective Date of the Agreement)

18. AEP Approves the Savings Report

    - (within 30 business days of SR submittal)

19. AEP Processes the incentive payment

20. **PS** Receives payment

G

Documentation For New & Retrofit Projects

NEW PROJECT – Documentation (hard copies)

- Lighting layout of the facility(s)
- Documentation on the square footage of the facility
- Manufacturing data on the HVAC efficiency ratings
- Signed Project Sponsor and Customer Agreement
- Signed Customer Acknowledgement Form
- Security Deposit
- Signed Agreement (between Project Sponsor and AEP)

RETROFIT PROJECT – Documentation (hard copies)

- Manufacturing data on the HVAC efficiency ratings
- Signed Project Sponsor and Customer Agreement
- Signed Customer Acknowledgement Form
- Security Deposit
- Signed Agreement (between Project Sponsor and AEP)

Customer Acknowledgement Form

AEP C&I Standard Offer Program

Project Name: _____ Project Number:_____

Project Location/Site (list all sites): _____

The signatures on this document certify that the energy efficient equipment associated with the project measures listed and describe in the Installation Report have been installed.

Project Sponsor

I hereby certify that the energy efficiency measures have been installed as described in this Installation Report:

Signature: _____

Print Name: _____

Title: _____

Completion Date: _____

Host Customer

I hereby certify that I am an authorized representative of the Host Customer and that the energy efficiency project has been installed as described in this Installation Report to the Host Customer's satisfaction:

Signature: _____

Print Name: _____

Title: _____

Approval Date: _____

I Project Sponsor and Customer Agreement

Project Sponsor and Customer Agreement

This document is only required for Project Sponsors (energy efficiency service providers) submitting a SOP Application on behalf of an AEP distribution customer. Please list each customer site.

Project Name: _____ Project Number:_____

Project Location/Site (list all sites): _____

Estimated: Start Date: _____ Completion Date:_____

1. Customer agrees to provide AEP, upon five (5) business days' prior oral notice, full and complete access to the project site for any purpose related to the C&I Standard Offer Program. Access shall be provided during Customer's normal business hours and in compliance with Customer's reasonable access requirements.
2. Customer acknowledges that any view, inspection, or acceptance by AEP of the project site or of the design, construction, installation, operation or maintenance of the measures is solely for the information of AEP and that, in performing any such inspection or review or in accepting the measures, AEP makes no representations or warranty whatsoever as to the economic or technical feasibility, capability, safety or reliability of the measures, their installation by the Project Sponsor, or their compatibility with Customer's facilities.
3. Customer acknowledges that the Project Sponsor is an independent contractor with respect to AEP and the C&I Standard Offer Program and that the Project Sponsor is not authorized to make representations or incur obligations on behalf of AEP.
4. A Customer acknowledgement that AEP is not a party to the Customer Agreement and that the Project Sponsor is solely responsible for performance thereunder.
5. A Customer acknowledgement that AEP makes no warranty or representation regarding the qualifications of the Project Sponsor, and that the Customer is solely responsible for the selection of the Project Sponsor.
6. A Customer acknowledgement that the Customer may file a complaint with the Public Utility Commission of Texas concerning the Project Sponsor, but that AEP will play no role in resolving any disputes that arise between the Customer and the Project Sponsor.
7. A Customer agreement to release AEP from any and all claims, demands, losses, damages, costs, and legal liability including, but not limited to 1) injury or death of persons, 2) damage to natural resources, 3) violation of any local, state, or federal law or regulation including, but not limited to, environmental and health and safety laws or regulations, 4) strict liability imposed by any law or regulation, 5) equipment malfunctions, or 6) energy savings shortfalls arising out of, related to, or in any way connected with the Project, regardless of any strict liability or negligence of AEP, whether active or passive, excepting only such claims, demands, losses, damages, costs, expenses, liability, or violation of law or regulation as may be caused by the active negligence or willful misconduct of AEP, and resulting from its acceptance of the project for participation in the C&I Standard Offer Program.

Customer Representative **Project Sponsor Representative**

Signature: _____ Signature: _____

Print Name: _____ Print Name: _____

Title: _____ Title: _____

Date: _____ Date: _____